

Suspended Solids Concentration - Turbidity Correlations: RM 10.9 Pre-Dredge Baseline and Historic RM 10.2 Surface Water Data

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Summary

The Water Quality Monitoring Plan (WQMP) supporting the RM 10.9 Removal Action requires that the correlation between turbidity and suspended solids concentration (SSC) be developed in a pre-dredge survey to justify the use of real-time turbidity measurements as a surrogate for SSC in the water column. During the June 2013 pre-dredge baseline sampling event, 340 water samples were collected and analysed. These data show a high degree of correlation between turbidity and SSC, similar to the correlation developed from 40 data points collected in earlier chemical and physical water column monitoring studies at RM 10.2. The significant correlation between turbidity and SSC in the June 2013 data set and the strong similarity to the correlation observed in the historical (2009 – 2013) data justify the use of turbidity for re-suspension monitoring during the RM 10.9 Removal Action. Furthermore, CH2M Hill believes that there is no need to further validate this correlation once dredging begins, and thus recommends that USEPA waive the requirement in Section 3.5 of the WQMP to develop an additional 80 data point turbidity-SSC comparison during the first 48 hours of dredging.

Introduction

The RM 10.9 Removal Action operations (i.e., dredging and capping) may suspend sediments into the water column and may be measureable in the immediate and downstream river environment. If SCC and turbidity can be correlated, turbidity would be a suitable parameter to assess potential construction-related water quality changes in real-time during the dredging and capping operations.

Continuous turbidity monitoring from June 1, 2013 to present has been conducted via four stationary buoys deployed on May 30-31, 2013 upstream and downstream of the RM 10.9 Removal Area. These data are supplemented by the pre-dredge baseline sampling event discussed herein, which was conducted June 19, 2013 through June 26, 2013. The pre-dredge baseline samples were collected in accordance with USEPA's Revised Surface Water Quality Monitoring Plan Outline dated May 31, 2013. These data were then compared against the historical turbidity-SSC correlation to determine if further sampling is needed to refine the correlation curve to be used during dredging and capping operations.

RM 10.9 Pre-Dredge Baseline Surface Water Data

The pre-dredge baseline sampling event included collection of surface water grab samples for laboratory analysis of SSC and concurrent *in-situ* measurement of turbidity. The samples were collected over a 10-day period, targeting 3 different tidal periods (ebb, slack [high or low], and flood) each day. These samples were collected in the vicinity of the four stationary buoys from two depths, surface (1 ft below water surface) and mid-depth (mid-point of the water column). Surface water grab samples and concurrent *in-situ* measurement of turbidity were also collected along transects situated near each of the four stationary buoys, and included 3 locations per transect (west, center, and east channel) and 2 depths (surface and mid-depth). A total of 340 co-located SCC-turbidity samples were collected during the pre-dredge baseline event. The correlation between these two parameters is presented in Figure 1. This figure also shows a breakdown of the four tide data subsets compared against the correlation curve (linear regression) for the overall dataset: (a) ebb tide, (b) flood tide, (c) slack high tide, and (d) slack low tide.

The p-value for the linear regression of the overall dataset is well below 0.001 indicating a high degree of statistical significance and the r-squared value of 0.82 indicates a high degree of correlation. In addition, the p-values for the individual tide data subsets indicate a high degree of statistical significance with all four values well below 0.001. These data collectively support the use of a single correlation curve to represent all tide periods.

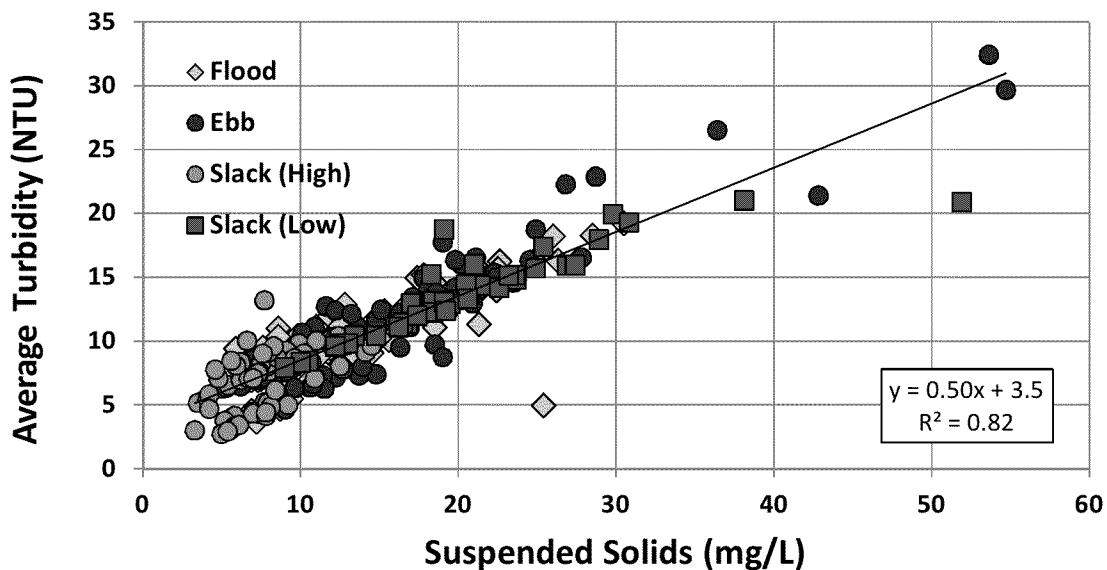
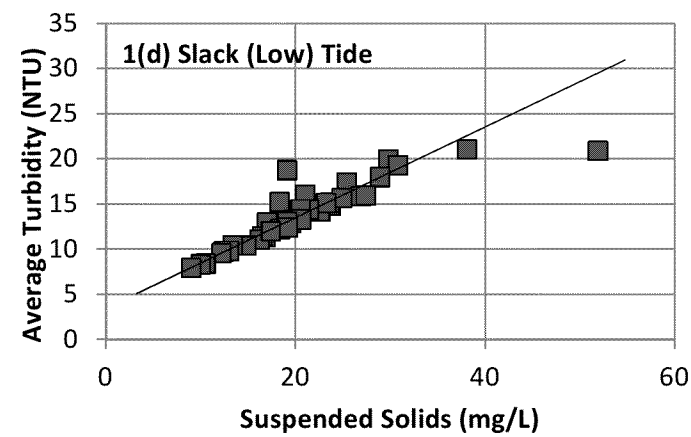
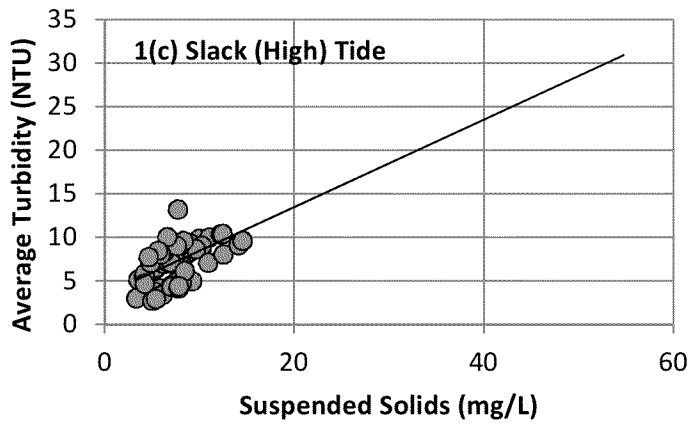
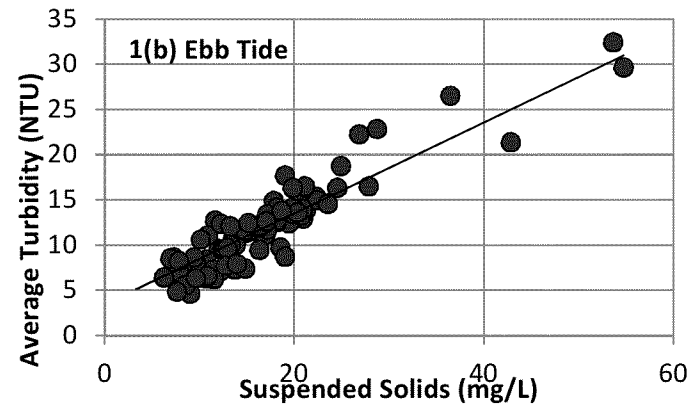
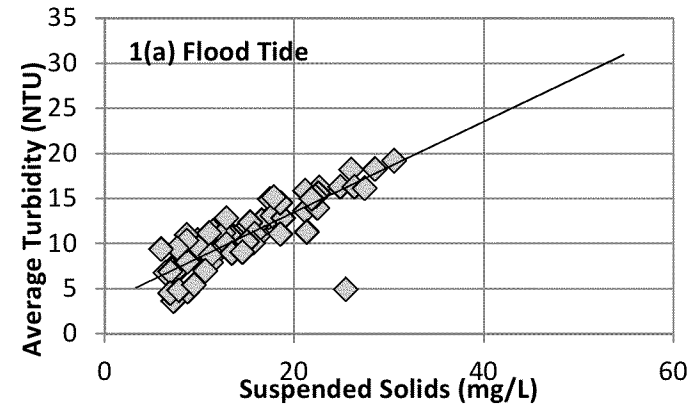


Figure 1. Pre-Dredge Baseline: All Tides



Historic RM 10.2 Surface Water Data

Since 2009, there have been two extensive data collection programs: the 2009-2010 Physical Water Column Monitoring (PWCM) program and the Small Volume Chemical Water Column Monitoring (SV CWCM) program, which were conducted as part of the Lower Passaic River Study Area (LPRSA) Remedial Investigation/Feasibility Study (RI/FS). The data generated from these programs include SSC and turbidity collected at RM 10.2, where stationary Buoy #1 is currently located. A total of 40 concurrent SCC-turbidity samples were collected from RM 10.2; those data are summarized in Figure 2. The data collected at RM 10.2 in support of the PWCM and SV CWCM programs were collected from 3 feet below surface and 3 feet above the bottom. SV CWCM samples were collected during slack high, ebb, slack low and flood tides during a variety of flow conditions and moon stages (i.e., spring and neap tides). Consistent with the pre-dredge baseline data, the p-value for the linear regression for this dataset is also well below 0.001 indicating a high degree of statistical significance and the r-squared value of 0.81 indicates a high degree of correlation.

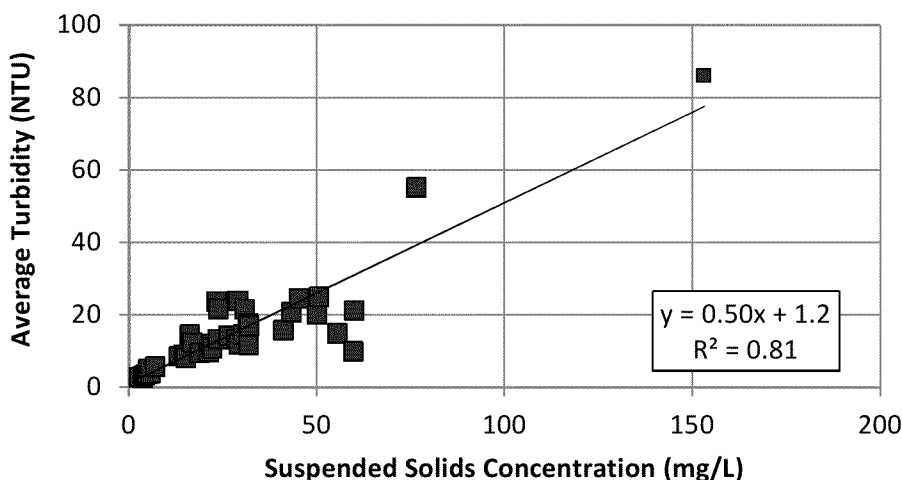


Figure 2. Historic RM 10.2 Data

Conclusions

A statistical comparison between the recently collected RM 10.9 pre-dredge baseline data and historic RM 10.2 data show no statistically significant difference in the correlation between suspended solids concentration and *in-situ* measurements of turbidity, in fact the slope of the curve is 0.50 in both datasets (See Figures 1 and 2). A further comparison between the historic RM 10.2 data and all data collected to date (pre-dredge baseline + historic RM 10.2) is presented in Figure 3 and shows no statistically significant differences.

Given these findings and the fact that all the linear regressions have a high degree statistical significance (p-value < 0.001) and correlation, the collection of additional data to further refine the linear regression correlation between suspended solids concentration and turbidity is not warranted.

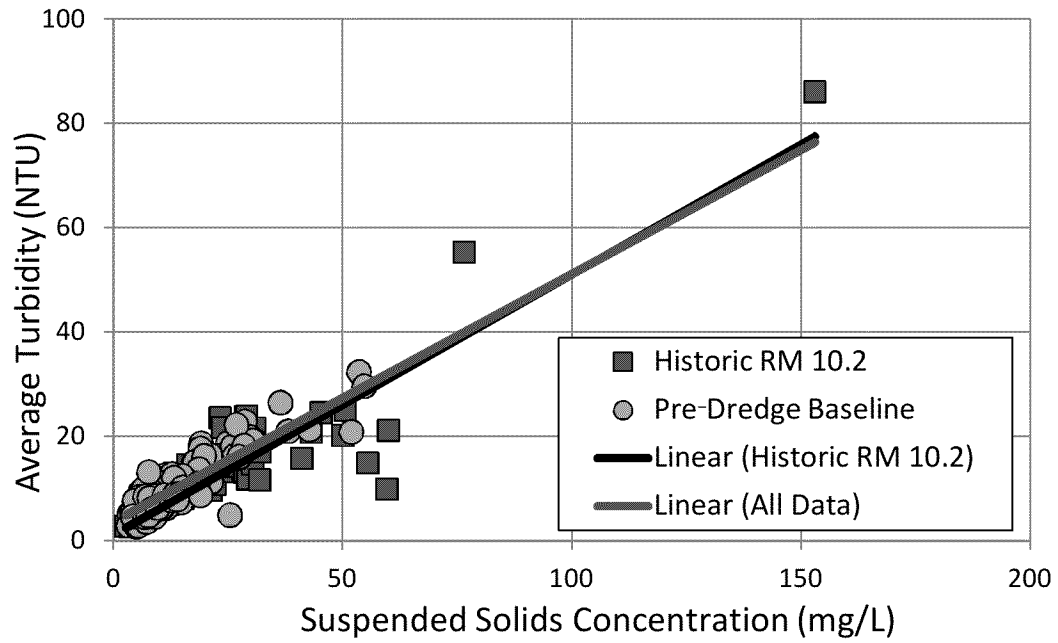


Figure 3. Data Correlations